COUNTRY PRACTICE IN ENERGY STATISTICS

Topic/Statistics: Energy use in the manufacturing sector

Institution/Organization: Statistics Norway

Country: Norway

Date: 2. April 2012

CONTENTS

Abstract

Write a short abstract of the statistics, and try to limit it to one page. The purpose of the abstract is to give the reader a general overview of the statistics/topic. It should therefore include a brief overview of the background and the purpose of the statistics, the population, the sample (if relevant), the main data sources, and the main users of the statistics. The abstract should also mention what is the most important contribution or issue addressed in the country practice (e.g. the practice deals with challenges of using administrative data, using of estimation, quality control, etc.). If there are other elements that are considered important, please feel free to include them in the abstract.

Keep in mind that all relevant aspects of the statistical production will be covered in more detail under the different chapters in the template. Therefore, the abstract should be short and focused on the key elements. What the most important elements are can vary from statistics to statistics, but as a help to write an abstract you can use the table below. The table can either replace a text or can be filled out in addition to writing a short text.

Key elements	
Name of the statistics	Energy use in the manufacturing sector
Background and purpose of the statistics	The purpose of the statistics is to provide information on energy consumption in mining and manufacturing. Since the 1970s, the energy consumption data have been collected as a part of the structural business statistics for manufacturing. As from the reference year 1998, the energy consumption data have been collected in a single survey, as a part of an ongoing project between Statistics Norway and the Norwegian Water Resources and Energy Directorate (Enova SF) from 2003. The purpose of this is to improve the quality of the energy consumption information and to develop and produce new statistics products. Since 1998, we have also been collecting data for self-produced energy.
Population, sample and data sources	Statistics on energy consumption in manufacturing consist of a yearly-based survey. The survey is based on questionnaires that are sent out in January the year after the reference year. The survey has a sample of 3,000 local types of activity units (local KAUs). The sample consists of the largest units in each subgroup and a stratified sample of small and medium-sized units. The units in the sample cover about 96 per cent of the total energy consumption in the mining and manufacturing sector. For other units, the energy consumption data are estimated.
Main users	The statistics are used by public institutions (The Norwegian Water Resources and Energy Directorate, the government, etc.), different analysis institutions and branch organisations. In Statistics Norway, the statistics are important input to the national accounts, the energy accounts and the energy balance sheet, as well as the emission statistics. The data are also important in other analyses and research in Statistics Norway.

Important contribution or issue addressed	Legal foundations and institutional agreements, sample selection, editing,
Other remarks	The majority of country practice is copied from a methodological analysis of the survey that was written in 2006-2007. The tables and examples are a few years old, but they are just as relevant today.

1. General information

1.1. Name of the statistics/topic

The statistics/topic could either be a specific energy statistics (e.g. electricity production) or a topic within energy statistics (e.g. energy balances). For more information, please see Section III of the Instructions.

Energy use in the manufacturing sector

1.2. History and purpose

State when the statistics were first published. Describe briefly the main purpose of producing the statistics and why it is relevant.

The purpose of the statistics is to provide information on energy consumption in mining and manufacturing. Since the 1970s, the energy consumption data have been collected as a part of the structural business statistics for manufacturing. As from the reference year 1998, the energy consumption data have been collected in a single survey, as a part of an ongoing project between Statistics Norway and the Norwegian Water Resources and Energy Directorate (Enova SF) from 2003. The purpose of this is to improve the quality of the energy consumption information and to develop and produce new statistics products. Since 1998, we have also been collecting data for self-produced energy. The statistics were first published in 1999.

1.3. Reference period

State the time period the data are collected for.

The previous year, 1. January – 31. December.

1.4. Frequency

Specify how often the statistics are disseminated (e.g. annually, monthly, quarterly, etc.). If the statistics are not produced at regular intervals, state at what times they have been produced in the past and the main reasons behind the irregularities.

Yearly. Preliminary figures are published within 6 months after the end of the reference year. Final figures are published within 18 months after the end of the reference year.

1.5. Dissemination

Describe how the statistics are published (e.g. printed publications, online publications, online databases, etc.). If applicable, include the web address to the main website of the statistics.

Preliminary and final figures are published at this web address: http://www.ssb.no/english/subjects/10/07/indenergi_en/ There are more tables in StatBank: http://statbank.ssb.no/statistikkbanken/?PLanguage=1

1.6. Regional level

State the lowest geographical level (e.g. administrative regions, municipalities, etc.) for which the statistics are made available to the public.

National level. Figures by county are available on request.

1.7. Main users

Identify the key users of the data and the main applications. Include both internal and external users, and if possible try to distinguish between end users and others.

The statistics are used by public institutions (The Norwegian Water Resources and Energy Directorate, the government, etc.), different analysis institutions and branch organisations. In Statistics Norway, the statistics are important input to the national accounts, the energy accounts and the energy balance sheet, as well as the emission statistics. The data are also important in other analyses and research in Statistics Norway.

1.8. Responsible authority

Write the name of the institution and department/office with the main responsibility for disseminating the statistics (e.g.: Statistics Norway, Department of Economics, Energy and the Environment).

Statistics Norway, Department of Economics, Energy and the Environment

1.9. Legal basis and legally binding commitments

State the national legal basis for the data collection. Include a complete reference to the constitutional basis, and web address to an electronic version (e.g.: The Statistics Act of 16 June 1989 No. 54, §§2-2 and 2-3, http://www.ssb.no/english/about_ssb/statlaw/forskrift_en.html).

The information is collected by Statistics Norway on behalf of Norwegian Water Resources and Energy Directorate under the act relating to the generation, conversion, transmission, trading, distribution and use of energy etc. [Energy Act] of June 29 1990 No. 50 § 10-1, third paragraph, first sentence. Web address: http://www.ub.uio.no/ujur/ulovdata/lov-19900629-050-eng.pdf Statistics Norway will, in accordance with the Statistics Act of 16 June 1989 no 54 relating to official statistics and Statistics Norway § 2-2 also use the information for the preparation of official statistics. Web address: http://www.ssb.no/english/about_ssb/statlaw/forskrift_en.html

If the data collection is not based on a legal basis, give a short description of other agreements or volunteer arrangements.

If applicable, give reference to national and international commitments that are legally binding (e.g. EU statistical legal acts).

1.10. Resource requirements

Specify how the production of the statistics is financed (e.g. over the ordinary budget, project based support, financial support from other institutions or organization). If applicable, state the contracting entity (e.g.: Ministry, EU Commission, OECD). A contracting entity is any entity which is ordering a survey or the compilation of a statistics, and paying for it

The statistics is mainly financed trough Enova SF, a public enterprise owned by the Ministry of Petroleum and Energy. A small part is also financed trough the ordinary budget of Statistics Norway.

Web address: http://www.enova.no/about-enova/about-enova/framework-conditions/262/0

Specify the resource requirements for producing the statistics (e.g. man-labour days, number of workers involved in the statistical production process of the statistics/topic in question).

1500-2000 hours each year (200-270 man-labour days).

1.11. International reporting

List any international organizations and names of reporting schemes that the statistics are reported to. If available, also include the website where the reported data are published (e.g. International Energy Agency, Monthly Oil Statistics, UNSD, etc.).

The figures are included in the energy balance sheet and the energy balance sheet is used in annual reports to the IEA/OECD.

2. Statistical concepts, methodology, variables and classifications

2.1. Scope

Describe the scope of the statistics (e.g. the statistics cover supply and use of all energy products in Norway, classified according to International Standard Industrial Classification of All Economic Activities – ISIC).

The statistics covers the consumption of purchased and own produced energy in manufacturing, mining and quarrying corresponding to EUs NACE Rev. 2 05, 07, 08, 09.9 and 10-33. It also covers a national 5-digit developed by Statistics Norway.

2.2. Definitions of main concepts and variables

Describe the main concepts (e.g.: territory principle, resident principle, net calorific value, gross calorific value).

The statistics covers the national territory, i.e. covers all manufacturing companies physically located in Norway. This coverage is referred to as the territory principle.

Describe the main variables (e.g. how are the different energy products defined in the statistics? How are production, intermediate consumption, final consumption, transformation, feed stock, the energy sector, etc. defined?).

The statistics include energy products bought for energy purposes and the consumption of energy produced by the unit. Energy products used as fuel during the reference year are included. Energy products used as input to industrial production are not included in the statistics. Because a large number of different energy goods are used within Norwegian industry, they need to be put into groups so that the published energy tables do not become too big and complex. There are 7 different groups:

Electricity: purchased and self-produced electricity
Petroleum products: purchased light heating oils, heavy distillates, heavy fuel oils, waste oils, kerosene and auto diesel, non-taxable
Gas: purchased and self-produced LPG, LNG, natural gas in gaseous, fuel gas and CO gas
Coal products: purchased coal, coke and petrol coke
Steam and district heating: purchased district heating and purchased and self-produced steam
Solid biomass and wastes: purchased and self-produced waste of wood, black liquor and hazard.
Waste petroleum products for transport: purchased gasoline, auto diesel taxable and marine gas oils.

For more details, se appendix A.

2.3. Measurement units

Describe in what unit the data is collected (e.g. physical unit (m3, metric tons), monetary unit (basic prices, market prices)). Describe in what unit the data is presented. Describe if the calorific values are collected (e.g. on a net vs. gross basis) and how they are used.

We ask for the consumption of different energy products in physical units, but in order to make it possible to find the total energy consumption within the individual energy groups and the total consumption for the company, we also converts all the energy products into the common unit MWh (million watts). This has been done based on information on average energy content for the individual energy goods. We also collect energy cost for the different purchased energy products in 1000 NOK.

If applicable, describe the density of the energy product(s) and the estimated *thermal efficiency coefficients* of different energy products and consumer groups or by appliance. Thermal efficiency coefficient indicates the share of the energy products which is actually usable for end consumption. Descriptions of density and thermal efficiency coefficient could alternatively be put in an annex.

Se appendix A.

2.4. Classification scheme

Include references to relevant international and national standard classifications. If national, give a brief description of the standards. If available, include web addresses to the electronic version of the standards).

The energy product definitions are similar and comparable to the Standard Energy Product Classification –SIEC in IRES.

2.5. Data sources

Give an overview of the different data sources used in the collection and compilation of the statistics/topic (e.g. household survey, enterprise/establishment survey, administrative data/registers, foreign trade statistics, production statistics and other primary/secondary data sources).

Examples of administrative sources/registers are: business register for enterprises and establishments, population register, land register, housing and building registers, tax registers, international trade registers, etc.

In addition to the energy consumption collected from the sample of local units in manufacturing, mining and quarrying, we use turnover data from the short-term turnover statistics (preliminary figures) and energy costs from the structural data for the manufacturing sector (final figures). These data are used to estimate energy consumption for units outside the sample. Information on activity codes, addresses and other information are also collected from the Central Register of Establishments and Enterprises of Statistics Norway.

In the structural data for the manufacturing sector, one of the questions concerns energy costs. These data are controlled against the energy costs in the statistics on energy consumption in manufacturing. The structural business statistics for manufacturing have a larger sample than the energy statistics and for the local types of activity units outside the sample of the energy statistics we use energy costs from the structural statistics. In addition to the structural business statistics, all enterprises in Norway have to report a standard industry form that covers income statement. For local types of activity units outside the sample of the structural statistics, we use energy costs from these standard industry forms. When we draw up the final figures for the energy consumption in manufacturing we then have energy costs for all units in the population and are able to make a good estimation of the total energy consumption in manufacturing.

See appendix B for a process map.

2.6. Population

Describe the entire group of units which is the focus of the statistics (the population).

Specify the following statistical units:

- Reporting unit
- Observational unit
- Analytical unit

Examples of different kind of statistical units include: enterprise, enterprise group, kind-of-activity unit (KAU), local unit, establishment, homogeneous unit of production.

In most cases the reporting unit, observational unit and analytical unit are identical, but there are examples where this is not the case. In electricity statistics, you may find that energy companies (the reporting unit) provide data about different consumers like the individual household or manufacturing company (the observational unit). The analytical unit may be a group of energy consumers, defined by the ISIC.

We use the Central Register of Establishments and Enterprises of Statistics Norway to create a new population. From the reference year 1998, the statistics cover all existing local KAUs within manufacturing, mining and quarrying, which correspond to division NACE Rev. 2 05, 07, 08, 09.9 and 10-33 in the International Standard Industrial Classification of All Economic Activities – ISIC. It also covers the national 5-digit level of the Norwegian Standard Industrial Classification.

There are about 20,000 units in the population.

Until 1997, enterprises with individual proprietorship where the owner is working alone (one-man enterprise), and other local KAUs with labour of less than half a man-year, are not included. Until 1997, there were about 12,000 units in the population. The change in the population from the reference year 1998 leads to a break in the statistics, but it is still possible to make a time series with the same population and contents as before 1998.

Reporting unit: Local KAUs
Observational unit: Local KAUs
Analytical unit: Energy consumption and energy costs

2.7. Sampling frame and sample characteristics

Describe the type of *sampling frame* used in the collection and compilation of the statistics (e.g. list, area or multiple frames). A sampling frame is the source material or device from which a sample is drawn. Note that the sampling frame might differ from the population.

For each survey(s) used for the compilation of the statistics, specify the *sampling design* (e.g. random, stratified, etc.). Describe the routines employed for updating the sample. Include information about the sample size, and discuss to what extent the sample covers the population (e.g. energy consumption in the sample compared to total energy use by the population).

Note that chapter *2.7: Sample frame and sample characteristics* may overlap with chapter *3.4: Grossing up procedures.*

Prior to 2003, turnover data was used to classify the local KAUs, but as from this year, employed persons have been used. This change was due to missing data for turnover for some of the local KAUs and because a better connection was found between employed persons and energy consumption.

The sample is designed in four steps.

Step 1. Choose big local KAUs

- Main rule: Local KAUs with more than 2 per cent of total employees in industrial subgroups.
- Exception: Local KAUs with more than 1 per cent of total employees in industrial subgroups consisting of many small units.

Step 2. Stratified sample of small units chosen randomly from small local KAUs:

After the two first steps, the sample size is about 2,600 local KAUs. The next step is to add a stratified sample of small units. Stratified means that we choose local KAUs by criteria. We identify industrial subgroups where the sample covers less than 70 per cent of total employees in the population. This is an industrial subgroup consisting of many small units. Then we randomly choose local KAUs from this stratum of subgroups according to these criteria.

Industrial subgroups < 50 local KAUs - Add 5 new units

Industrial subgroups > 50 local KAUs - Add 10 new units

In order to make a correct estimation of energy consumption for units outside the sample it is important to include a random stratified sample of small units in the sample, thus avoiding systematic errors in the estimation. The small units in the sample also best reflect the energy consumption in units outside the sample. It is important that the sample covers a high percentage of total energy consumption in every industrial subgroup. We therefore need a stratified sample. About 450 local KAUs are chosen in this step.

Step 3. Add more local KAUs to industrial subgroups with less than 7 units:

The last step is to add more local KAUs to industrial subgroups with less than 7 units in order to ensure we have a high coverage in every industrial subgroup.

- Main rule: minimum 7 local KAUs in every industrial subgroup
- Exception: industrial subgroups with less than 7 local KAUs

After step three, the sample consists of about 3,200 local KAUs. In 2006, the sample consisted of 3,170 units and covered 76.4 per cent of total employees and 96.1 per cent of total energy consumption.

The thousand largest local KAUs account for about 94 per cent of the total energy consumption in manufacturing and mining. Table 1 shows the status after the different steps of sample design.

Table 1: Status sample design 2006:

Sample design	Local KAUs	Employees	Local KAUs in %	Employees in %	Energy consump. in %
Population	21,194	243,502	100%	100%	100 %
Step 1	2,590	178,801	12.2%	73.4%	95.2%
Step 2	431	5,943	2.0%	2.4%	0.6%
Step 3	149	1,334	0.8%	0.6%	0.3%
Final sample	3,170	186,078	15.0%	76.4%	96.1%

Step 4. Controls:

We need to check that all large local KAUs and large energy users are included in the sample. We also need to control that the sample covers a high percentage of the total energy consumption in every industrial subgroup. We control against the sample for the previous year and the Central Register of Establishments and Enterprises. In industry subclasses with few large local KAUs, the sample covers nearly 100 per cent of total employees in the population. These are industries such as the pulp and paper industry and basic metals. In industry subclasses with many small local KAUs, the sample covers from 50 to 80 per cent of total employees in the population. These are industries producing food products, textiles etc. Appendix D shows the sample cover for all industrial subclasses.

2.8. Collection method

For each survey used for the compilation of the statistics/topic, describe how the data are collected (e.g. face-to-face, telephone, self-administered, paper and internet-based questionnaires, or administrative data and registers).

We use internet-based questionnaires and send out information letters with online username and password. About 94 percent report electronically. Respondents who want to report on paper forms, must order themselves trough SSBs answering service. A copy of the 2006 questionnaire is included in appendix C (the 2011 looks the same except question 3).

The work of creating new, or changing existing questionnaires, starts at the same time as we start with the new population (Appendix B). We collaborate with The Norwegian Water Resources and Energy Directorate on this. Because a large number of different energy goods are used within Norwegian industry, we need a 4-page form. Small local KAUs mostly use electricity and therefore it is possible to use smaller forms for these units. Therefore we use two kinds of forms, one for industries with many energy-intensive local KAUs and an easier form for industries with mainly small local KAUs. These reduce the response burden for small local KAUs. Appendix C shows the paper form for industries with energy-intensive local KAUs.

We have some instructions and advice on how to answer the questionnaires in the form. A letter with information on the purpose of the statistics, contact persons and that the units are required to respond is enclosed. The Statistics Act is applied. Every small local KAU gets its own user name and password for the electronic form.

2.9. Survey participation/response rate

For each survey used for the compilation of the statistics/topic, specify the average response rate, or refer to response rates for specific surveys conducted.

The average response rate is between 95-97 percent.

3. The statistical production process

3.1. Data capture and storage

Describe how the data is captured and stored (e.g. if the respondent replies using Internet-based questionnaire, the received data are electronically transferred to the production database. Paper questionnaire responses are keyed manually to the production database).

Micro data, original and revised data for the sample, and the estimated data for local kind of activity units outside the sample, are stored in Oracle databases and as SAS-datasets.

3.2. Data editing

Describe the regular routines employed for detecting and correcting errors. This may include:

- Manual routines for detecting and correcting errors
- Automatic error-detection (and correction)
- Micro- and macro editing procedures
- Data validation procedures
- Outlier identification

- Processes and sources used for quality controls

The questionnaires are transferred directly from the web reporting channel to the revision database every night. First, we sort the incoming forms between the two questionnaire types; energy intensive KAUs and small KAUs. We also sort variables like total energy consumption, total energy cost and the percentage difference between this year and last year by increasing or decreasing order. This is to control for major differences in the energy consumption and energy costs for the local KAUs from the previous year. A common error is the wrong amount; KWh instead of MWh. For errors that are not so obvious, a closer revision is undertaken. This method is a very effective way of washing the data before carrying out a closer control of the units with the largest energy consumption.

After controlling for major differences, a more detailed inspection is carried out of the units with the highest energy consumption. The units are classified according to the following criteria:

Group 1: Energy consumption > 50 GWh (about 120 units)
Group 2: 10 GWh < energy consumption < 50 GWh (about 280 units)
Group 3: Energy consumption > 5 GWh or/else energy cost. > NOK 1 million (about 600 units)
Group 4: Energy consumption < 5 GWh or/else energy cost. < NOK 1 million (about 2,200 units)

The local KAUs in group 1 have the highest priority and will be controlled first. Here we have a more detailed consistency check against the previous year and against energy costs in the Central Register of Establishments and Enterprises. If we find errors in the data, we contact the local KAUs. Units in group 4 are primarily checked for major differences in step one in the revision, but we also have a more detailed check for some units.

Editing by priority, which was implemented in 2004, is an effective way of carrying out quality controls. Automatic editing and editing by priority have reduced the working hours on editing and improved the timeliness of the statistics by nearly half a year. More focus on the energy-intensive local KAUs has also increased the quality of the data. This can be measured by the deviation between preliminary figures and final figures in the statistics. Final figures are published a year after the preliminary figures, at which time consistency checks can be carried out on energy costs from the structural data for the manufacturing sector. This makes final figures more certain than preliminary figures, but after the introduction of revision by priority the deviation between preliminary and final figures for energy consumption is less than 1 per cent. The deviation was previously about 2 per cent. This may be explained by the fact that we now detect serious data errors at an earlier stage than before.

Editing is the most labour-intensive part of the statistics production. In 2006, 1,016 hours were spent on editing the statistics on manufacturing and mining. Around 200 hours were spent on controlling the 2,059 respondents in group 4, 100 hours on controlling serious errors and 100 hours on detailed checks. A total of 818 serious errors were found and corrected in 454 local KAUs in 2006. Most of these errors where found in small local KAUs. We then spent around 800 hours on the detailed inspection of the units with the highest energy consumption. A total of 1,492 errors were detected and corrected in the detailed check. A total of 1,011 local KAUs were classified in groups 1 to 3 in 2006, and data was corrected in 462. Because of the importance of these units, all data must be perfect. A great deal of time was therefore spent editing each unit. Table 3 shows all details in the editing work.

Table 3: Editing work 2006:

Activities	Local KAUs	Local KAUs with error	Number of errors	Working hours	Energy consump. in TWh after edit.
Editing, total work	3,070	1,044	2,310	1,016	81.1 TWh
Editing, group 4	2,059	582	1,136	ca 200	1.6 TWh
Editing, groups 1-3	1,011	462	1,174	816	79.5 TWh

Total serious errors		454	818	ca 100	
Total detailed checks		590	1,492	916	

Table 4 shows the total energy consumption and costs in the sample before the automatic correction, after the automatic correction and after we have finished the editing work for the reference year 2006. From this table we see the importance of editing the raw data we get from the respondents. We have many serious errors caused by wrong amount in the raw data and total energy consumption and total energy costs are much higher than the true values. It is necessary to correct these errors before we start the detailed editing. From the table we see that the detailed check also is important, because there are still many errors left after the automatic correction.

The automatic correction removes most of the errors with wrong amount. We have more problems with wrong amount in the energy costs (NOK instead of the asked NOK 1,000) than in the energy consumption. We believe this problem arises from not optimal user instructions in the questionnaires and for the reference year 2007 we try to improve the user instructions to reduce this problem. In general we use a lot of resources to improve the questionnaires to reduce errors in the sample.

Table 4: Status editing. Preliminary figures. 2006:

	Raw data Before automatic correction	After automatic correction Before detail check	The sample after the detailed checks
Total energy consump.	120.3 TWh	83.6 TWh	81.1 TWh
Total energy costs	212,990 million NOK	19,262 million NOK	14,998 million NOK

<u>Controls</u>:

We have four types of controls in the revision database. Price controls, controls against last period, a duplicate control and automatic corrections. These controls were developed to make editing more efficient and to improve data quality. The automatic correction happens when the data is transferred from then online reporting channel into the revision database. The other controls only “flags” possible errors with an error message.

- Price controls: This control “flag” the energy products if the derived average price lies outside a certain interval ($x = \{\alpha \leq x \leq \beta\}$). For most energy products, this means that the historically 5 percent lowest and highest values are “flagged”.
- Controls against last period: This control applies to KAUs that are in the sample to years in a row. The control will “flag” if the percentage change rate is greater or less than a fixed limit ($| Ri | = ((xi - xi\text{-}1/xi\text{-}1) * 100) = \{\alpha \leq \tau \leq \beta\}$).
- Duplicate control: This control “flags”if the KAU has sent in two questionnaires.
- Automatic corrections: We have some problems with KAUs reporting in kWh instead of MWh and NOK istead of 1000 NOK. So if the relationship between reported value this period and last period is greater than 750 or less than 1/750, the value should be automatically corrected. If a KAU reports a consumption of 2500 MWh in 2010 and 2700 000 MWh, the value will be automatically corrected to 2700 MWh.

3.3. Imputation

Describe the principles for imputation and the assumptions that these principles are based on.
Note that this chapter may overlap with chapter *3.2: Data editing* and chapter *5.2: Accuracy*

3.4. Grossing up procedures

Describe how the population is divided into strata and what statistical models the estimations in the strata are based on. Describe how sub-indices are combined into aggregate indices and how uncertainty is estimated.

Energy data of the units in the sample is used to estimate the energy consumption of units outside the sample. Together with turnover data from the short-term turnover statistics (preliminary figures) and energy costs from the structural data for the manufacturing sector (final figures), this enables us to make an accurate prediction of energy consumption for the whole population. Some energy goods are only used by a few large units in the sample and are not included in the estimation of the energy consumption of units outside the sample.

Model and estimation
The common ratio model is being used in the estimation. This model assumes a linear connection between the dependent variable y and the independent variable x.

$$y_i = \beta x_i + \varepsilon_i \qquad E(\varepsilon_i) = 0 \text{ and } \operatorname{var}(\varepsilon_i) = \sigma^2 x_i$$

First we predict energy costs from turn over data (preliminary figures). In the final figures we have the energy costs. Then we estimate energy prices, and finally energy consumption. Energy prices are a weighted average of observed prices in the sample.

$$Price = \frac{1}{n}\sum_i price/unit \;\; i = \frac{1}{n}\sum \frac{1000kr}{MWh}$$

Energy consumption (MWh) is then estimated from estimated or observed energy costs (NOK 1,000) and prices.

$$MWh = \frac{Costs}{Price}$$

3.5. Analytical methods

Give a description of any analytical methods used to adjust the data (e.g.: seasonal adjustment and temperature adjustment). A more detailed description of the analytical method can also be included as an annex.

4. Dissemination

4.1. Publications and additional documentation

Describe the form of dissemination of the statistics/topics in question (e.g. printed publications, website, etc.). Please provide relevant website link(s) if available.

Preliminary and final figures are published at this web address:
http://www.ssb.no/english/subjects/10/07/indenergi_en/

Give a complete reference to publicly available statistics databases where data from the statistics can be extracted. Include web addresses if available online.

The data is available on the online database StatBank Norway on this web address:
http://statbank.ssb.no/statistikkbanken/Default_FR.asp?PXSid=0&nvl=true&PLanguage=1&tilside=selecttable/hovedtabellHjem.asp&KortnavnWeb=indenergi

Indicate whether you charge users for access to the statistics at any level of aggregation.

We charge users for access to statistics that are not available in the Statbank Norway and that takes more than 30 min to prepare.

4.2. Revisions

Describe the current revision policies. E.g.: Is historical data revised when new methodology, new definitions, new classifications etc. are taken into use? Is the data continuously revised, or is the data revised at certain points in times (e.g. every third year, annually, etc.)?

If applicable, describe any major conceptual or methodological revisions that have been carried out for this statistic/topic in the past.

4.3. Microdata

Describe how microdata are stored.

Micro data, as well as the data from the questionnaires and the revised data for the sample, and the estimated data for local kind of activity units outside the sample, are stored in Oracle databases and as SAS data

Specify if microdata are available for scientific and/or public use. If so, describe under what conditions these are made available.

Researchers at approved research units can order data at an individual level. Such data may be ordered according to special conditions. Se this web site: http://www.ssb.no/english/mikrodata_en/

4.4. Confidentiality

Describe the legal authority that regulates confidentiality, and what restrictions are applied to the publication of the statistics.

§ 2-6 of the Statistics Act states that under no circumstances shall data be published in such a way that they can be traced back to the supplier. This means that the general rule is not to publish data if there are fewer than three enterprises in an industry. In cases with less than three enterprises in an industry group, data are confidential and aggregated up to a more aggregated industry group before publishing.

Describe the criteria used to suppress sensitive data in statistical tables (cell suppression).

We suppress data if there are fewer than three enterprises in an industry.

Describe how confidential data are handled.

Describe any confidentiality standards that go beyond what is legally required.

5. Quality

5.1. Relevance

State to which degree the statistical information meet the real needs of clients/users.

Very good.

5.2. Accuracy

State the closeness of computations or estimates to the exact or true values that the statistics were intended to measure.

We can never now the exact true value from a sample survey, but we expect the estimates to be very close. More information further into this chapter.

Measurement and processing errors
Discuss the measurement and processing errors that are relevant for the statistics. Try as far as possible to give an estimation of the size and scope of the errors.

Measurement errors may occur in the data due to misunderstandings or lack of knowledge. Most respondents are not energy experts and may find it difficult to answer all the questions. Thus we try to guide them with user instructions and advise them if they contact us. We also use a great deal of resources on making optimal questionnaires. Another problem is reporting energy products in the right physical unit. For instance, the supplier may report a gas product sold to the local KAUs in cubic metres and we want it reported in MWh. When the local KAUs then convert it from cubic metres to MWh, inaccuracies can occur. We try to help the local KAUs with converting energy products from one unit to another, but sometimes we don't know how to do it either. We always ask for the most common unit, but some energy products have numerous units of measurement.

A third problem worth mentioning is the respondents' problem in finding all energy data. Local KAUs may have many energy suppliers and it may be difficult to find the total energy consumption.

The final measurement problem covered here is the problem with wrong amount. We want the respondents to report in 1,000 KWh and NOK 1,000. This is because some of the local KAUs are very energy intensive, but it leads to reporting errors. Many small local KAUs in particular report wrong amounts.

Misunderstandings leading to serious errors and obvious and common errors are identified and corrected in the program for controlling major differences and in the detailed check of energy data. Serious errors arise from reporting energy consumption, and energy costs with wrong amounts are easy to detect because of the large difference compared to the previous year. We usually have a similar error situation in connection with converting energy units. All serious errors in the statistics are corrected and this removes most of the uncertainty. In addition, we correct most non-serious errors for large energy users in groups 1 to 3 in the detailed consistency check and in the final control. The extent of measurement errors in the statistics on energy consumption is therefore small.

Few processing errors have been attributed to errors in the optical reading and to the transmission of data from the electronic forms to the Oracle database in recent years. We have used a great deal of resources to create a good infrastructure in recent years.

Serious processing errors due to quality controls will be detected in the final control of energy consumption, after the revision is complete. Smaller errors are often first observed when individual data is used for analysing. Not all personnel carrying out quality controls are energy experts and this can lead to some wrong decisions, but it is not a major problem.

Non-response errors

State the size of the unit non-response and the item non-response, distributed by important variables in the population (e.g. region, industry). Consider if the non-response errors are systematic, and if so, describe the methods used to correct it. Indicate whether the effects of correcting non-response errors on the results have been analysed, and, if so, describe them.

Non-response errors are low in this survey. A total of 3,057 local KAUs responded to the survey in 2006; a response rate of 96.4 per cent. All large energy users with a consumption of energy above 10 GWh responded. A total of 167 small local KAUs reported non-usable data. Examples of non-usable data are units writing "1" for all energy products. We contact some of these respondents, but do not have the capacity to contact them all. A total of 280 local KAUs did not respond or did not report usable data in 2006, but these were all small energy users and the non-response errors did not have a serious effect on the quality of the statistics. The units reporting data account for around 96 per cent of the total energy consumption in 2006.

Even if non-response errors are not a major problem in these statistics, they may cause problems in some industry subclasses. When we detect industry subclasses with high non-response errors we contact some of the missing local KAUs. At the end of the revision we then have a minimum number of respondents in all industry subclasses. We estimate energy consumption for non-response local KAUs in the same way as for units outside the sample.

Another problem is units that have failed to answer some questions in the survey. Most local KAUs have information on energy costs, but some units have no information on the consumption of all energy products. In these cases, we estimate the energy consumption from energy costs divided by references prices. Reference prices are formed from prices from the seller of an energy product and prices of the energy products in the sample. Item non-response is not a major problem in these statistics. Less than one per cent of the total energy consumption is estimated in this way.

Sampling errors
Discuss the size of the sampling errors. Compare the population and sample with regards to important properties (e.g. coefficient of variance).

Sampling errors arise from the fact that the estimates are based on a sample and not a census of the entire population. These errors may be measured by the coefficient of variance. The coefficient of variance (CV) measures the standard deviation as a percentage for a published value and indicates the quality of the estimates. A high CV indicates high uncertainty in the estimates.

The coefficient of variation is estimated from a model of standard deviation as follows:

Let $t^k = \sum_i y_i^k$ be the population total of variable *k*; (here *k* = energy cost). The population total, t^k, is estimated by $\hat{t}^k$.

The variance of the estimated population total, $\hat{t}^k$, is estimated by a ratio model:

$$y_i^k = \beta^k x_i + \varepsilon_i^k \quad ; \qquad Var(\varepsilon_i^k) = \sigma_k^2 x_i$$

where turnover is used as auxiliary variable x_i for all variables *k.*

Subsequently,

$$V\hat{a}r(\hat{t}^k - t^k) = \frac{\sum_U x_i \sum_{U-s} x_i}{\sum_s x_i} \hat{\sigma}_k^2$$

where σ_k^2 is estimated by:

$$\hat{\sigma}_k^2 = \frac{1}{n-1} \sum_s \frac{(y_i^k - \hat{y}_i^k)^2}{x_i^k}$$

for all variables *k,* independent of both the model and the auxiliary variable utilised in estimating $\hat{t}_k$.

Hence, the coefficient of variation is:

$$C\hat{V}(\hat{t}_k) = 100 \frac{\sqrt{Var(\hat{t}_k - t_k)}}{\hat{t}_k}$$

A central value and a key variable in this survey is the total energy cost. Together with total energy consumption, total energy cost is the most central value in these statistics since these variables provide the most important information on the development in the energy use in manufacturing and mining. As explained in chapter 4.6, we use energy costs to estimate the energy consumption. In preliminary figures we estimate the energy costs from the short-term turnover statistics. Total energy costs for manufacturing and mining amounted to NOK 14.6 billion in preliminary figures in 2005[1]. As shown in table 5, the coefficient of variance was only 0.7 per cent for manufacturing and mining in total. The main reason for this low uncertainty is that the sample covers a high percentage of total turnover and

[1] We use data from the reference year 2005 in this chapter because this is the last year with both preliminary and final figures of the statistics. The methods of sample design, number of units in the sample and the methods of estimation are nearly identical with the reference year 2006.

energy costs in this survey. Large local KAUs in the sample account for a large amount of total turnover and energy costs in the population. In general, surveys where the sample covers a large amount of the population will have a low CV.

In some industry subclasses we find a higher coefficient of variance than for manufacturing in total. These errors may be caused by low coverage ratio, large spread in the level of energy costs for the units in the sample or model misfit. Table 6 shows an estimated CV of 1.9 and 1.7 for industry subclasses such as basic chemicals and basic metals, even where they have a high share of the turnover in the sample. Nevertheless, sampling errors are low in most industry subclasses in these statistics. This is mainly due to a high coverage ratio in the sample. A total list of coefficients of variance by industry subclass is enclosed in appendix E.

Table 6: Sampling errors measured by coefficient of variance of total energy costs 2005. Preliminary figures. Extract.

Industry subclasses	Local KAUs in population	Local KAUs in the sample	Turnover in sample %	Energy costs in sample %	CV %
Manufac. and mining, total	21,195	2,945	90.0	92.1	0.7
Fish products (15.2)	560	220	85.0	86.9	1.8
Dairy products (15.5)	87	58	94.5	96.1	2.0
Pulp and paper (21.1)	34	22	98.8	99.6	0.7
Articles of paper (21.2)	80	26	88.5	94.3	4.8
Basic chemicals (24.1)	94	51	99.2	99.7	1.9
Aluminium (27.4)	38	23	95.7	99.9	1.7

A usual problem with estimation is skewed sample. The local KAUs in the sample are rather large and energy-intensive units, while the units outside the sample are rather small and not energy intensive. In order to avoid problems with the estimation model, large units are weighted according to the sample design and are not used for estimation. It is important to have enough small local KAUs in the sample to be able to make a good estimation. This shows the close link between sampling design and estimation. Errors in the variable we use to estimate the energy costs can also increase the variance. Turnover data from the short-term turnover statistics may be uncertain and in some cases not usable for predicting energy costs.

Even if we have some errors and some uncertainty in the preliminary figures of this statistics, the total quality is high. A way of measuring the quality of the estimates is to compare preliminary figures with final figures. When estimating the energy consumption for units outside the sample in the final figures, we use energy costs from the structural data for the manufacturing sector. These data are significantly better than the turnover data from the short-term turnover statistics used in preliminary figures because Statistics Norway personnel control them in detail. Preliminary figures are published within 6 months of the end of the reference year, while final figures are published within 18 months of the end of the reference year, when we have more and better information on the data. This leads to a higher quality in the final figures.

Table 7 shows that the deviation between preliminary figures and final figures is low and has decreased since the year 2000. This is a sign of high quality in the estimates for preliminary figures, and the significant lower deviation since 2003 tells us that the new editing system (editing by priority) has improved the quality of the statistics. Around 50 per cent of the deviation is due to changes in energy data after we published preliminary figures and is not a consequence of errors in turnover data.

Table 7: Deviation between published data in preliminary figures and final figures						
Reference year	Total energy use in prelim. figures (TWh)	Total energy use in final figures (TWh)	Deviation %	Total energy cost in prelim. figures (Mrd)	Total energy cost in final figures (Mrd)	Deviation %
2000	80.2	81.7	1.9%	10.8	11.2	3.7%
2001	80.1	83.6	4.3%	11.6	11.8	1.7%
2002	78.2	79.5	1.7%	10.9	11.2	2.8%
2003	82.1	83.3	1.5%	12.4	12.4	0
2004	85.2	85.5	0.4%	13.5	13.7	1.5%
2005	86.1	85.8	0.4%	14.8	14.6	1.4%

Other sources of error
Discuss other sources of errors that might be relevant for the statistics. E.g.: Model assumption errors, coverage errors

Coverage errors or frame errors in the statistics are not important problems in these statistics. We use the Central Register of Establishments and Enterprises of Statistics Norway to control for classification problems, and classification changes in this register are updated. There is no seasonal adjustment in these statistics.

5.3. Timeliness and punctuality

Specify the time between the end of the reference period and publication.
If the statistics are published both as preliminary and final figures, specify the time between publication of preliminary and final figures. You should also point out whether the publication date is set according to certain rules (e.g. advance release calendar, a specific day or prior to other publications).

Preliminary figures are published within 6 months after the end of the reference year. Final figures are published within 18 months after the end of the reference year.

Point out if there have been any major discrepancies between the planned publication date and the actual publication date in recent years. If so, state the length of this discrepancy and its cause.

5.4. Accessibility

Describe how easily accessible the statistics are. In particular, is there an advance release calendar to inform the users about when and where the data will be available and how to access them?

Statistics Norway announces all statistics at least 3 months in advance on this website: http://www.ssb.no/english/subjects/calendar/calendar4m.shtml

Are metadata and other user support services easily available? Are there particular groups that don't have access to the published statistics (e.g.: visually disadvantaged)?

Metadata and user support services are easily available. Statistics Norway has several internal units working with service and support.

5.5. Comparability

Discuss the comparability of the statistics over time, geographical areas and other domains.

Comparability over time
Discuss comparability over time and include information about whether there have been any breaks in the time series of the statistics and why. Also describe any major changes in the statistical methodology that may have had an impact on comparability over time.

Since the reference year 1998, the statistics cover all local KAUs in mining and manufacturing. Prior to 1998, enterprises with individual proprietorship where the owner was working alone (one-man enterprise), and other local KAUs with labour of less than half a man-year, were not included. New production routines and more recourse for revision have led to higher quality data from 1998. The new population and contents in the statistics, as well as higher quality of the data, led to a break in the statistics in 1998. It is still possible to continue the old time series with the same population and contents as before 1998.

Changing the activity classification from the UN's ISIC Rev 2 to the EU's NACE Rev. 1 led to a break in the statistics for energy consumption in mining and manufacturing in 1993. For the years 1990-1993 the old ISIC data is converted, so that there exists comparable time series for the energy industry from 1990. We also have a break from 2007 when we adapted EU's NACE Rev. 2. Time series are therefore available in StatBank Norway by NACE Rev 1. for 1990-2008 and by NACE Rev. 2 for 2007-2010.

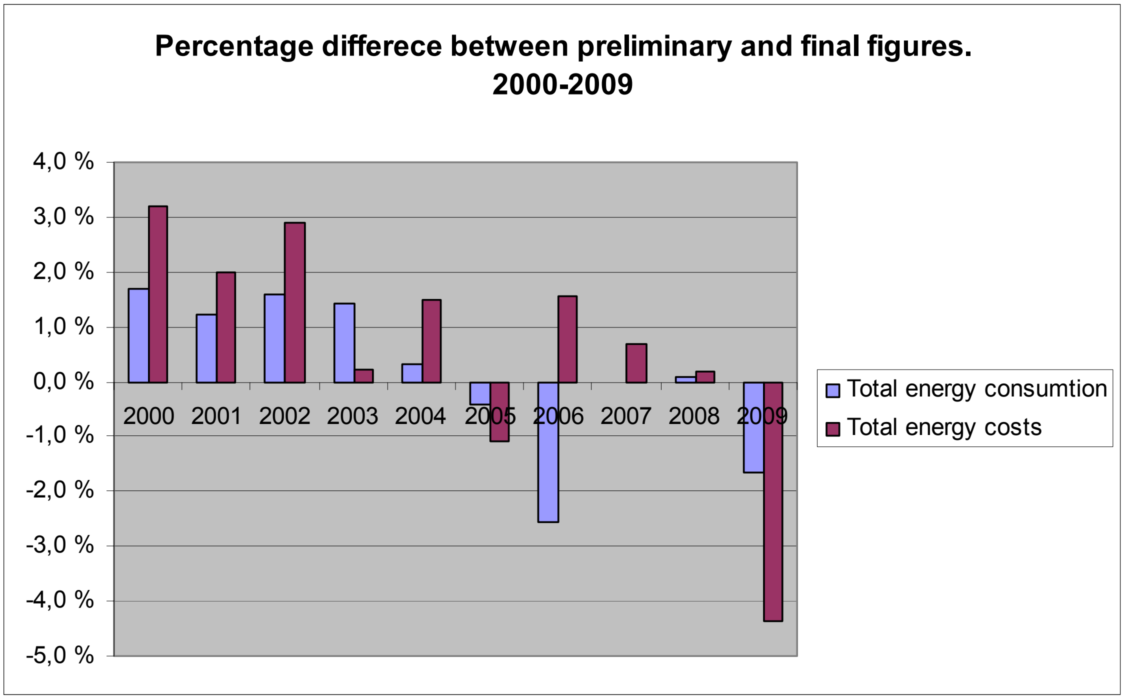
Comparability over region
Discuss comparability over geographical areas, and include information about whether the statistics are comparable to relevant statistics published by other countries and/or international organisations.

Comparability over other domains
Discuss comparability over domains, and include information about whether the statistics are comparable between different industries, different types of households etc.

5.6. Coherence and consistency

Discuss the coherence/consistency between preliminary and final figures.

The preliminary figures are predicted using short-term turn over statistics and the energy cost from the structural manufacturing data are used for estimating the final figures. It's a better coherence between energy costs and energy consumption, than with turn over statistics and energy consumption. There is on the other hand no pattern when it comes to the difference between preliminary and final figures. An explanation of is that the final figures are more thoroughly edited than the preliminary figures.



Discuss the coherence/consistency between monthly, quarterly or yearly statistics within the same subject area. Can the results of different frequencies for the same reference period be combined in a reliable manner?

Discuss the coherence/consistency with other related statistics (also those produced by other institutions/organisations on the same subject).

The total energy cost data in the statistics on energy consumption in the manufacturing sector are identical to the total energy cost data in the structural business statistics for the manufacturing sector. This connection between the two statistics provides the potential for producing energy indicators, where the energy consumption data are connected with different activity data, for example number of hours worked by employees, employment, value added, production value, etc.

Consumption of electricity is adjusted against the electricity statistics.

The statistics on energy consumption in the manufacturing sector are important input to the energy accounts, the energy balance sheet, emission statistics and the national account.

6. Future plans

Are there any current or emerging issues that will need to be addressed in the future? These could include gaps in collection, timeliness issues, data quality concerns, funding risks, confidentiality concerns, simplifications to reduce respondents' burden etc.?

There are no or few emerging issues. The goal is continuous improvement, especially when it comes to efficiency and data quality.

One issue that we should address is the comparability over time regarding the adaption of new industry classifications (e.g. EUs NACE Rev.1 to EUs NACE Rev.2). The break in 2007 should be recalculated until 1990.

Annexes

Illustrations and flowcharts

Illustrations and flowcharts are useful to summarize information and to get a better overview of the statistical production process. Illustrations and flowcharts can either be places in annexes or be included under relevant paragraphs in the template.

E.g.:

- A conceptual flowchart which illustrates the flow of data in the production of the statistics.
- A flowchart which illustrates the main tasks in the production process and the dependency between them.

Time schedule

Include a time schedule for the different phases of the statistical production process. The statistical production process *may* be divided into the following phases. Phase 1-3 may only be relevant for when a new statistics/survey is set up.

1. **Clarify needs** (e.g. map users needs, identify data sources)
2. **Plan and design** (e.g. plan and design population, sample size, how to analyze and edit data)
3. **Build** (e.g. build and maintain production system, test production system)
4. **Collect** (e.g. Establish a frame, draw the sample, collect data)
5. **Edit** (e.g. identify and code micro data, edit data, imputation)
6. **Analyse** (e.g. quality evaluation, interpret, analyse)
7. **Disseminate** (e.g. publish data, user contact)

Questionnaires

Include the complete questionnaire(s)/survey form(s) used

Example of publication tables

Include an example of a typical table published for the statistics. Include web addresses if available online.

Detailed description on analytical methods

If relevant, a detailed description of analytical methods used in the statistical production (like seasonal adjustment, temperature adjustment etc.) may be described in an annex. A short description can also be included in chapter 3.5: Analytical methods or under other suitable chapters.

Appendix A: Variables and conversion factors 2011

Energy product	Physical unit	Coversion to MWh
Electricity#1	MWh	1
Petroleum products (excl. used for transport)		
Kerosene	tonnes	11,97222
Light heating oils	tonnes	11,97222
Heavy distillates	tonnes	11,97222
Heavy fuel oils	tonnes	11,27778
Waste oil	tonnes	10
Auto diesel, non-dutiable	tonnes	11,97222
Gas		
Propane and butane	tonnes	12,80556
Liquified natural gas (LNG)	tonnes	12,5
Natural gas (in gaseous form)	1000 Sm3	9,92 #3
Fuel gas	tonnes	13,88889 #3
CO-gas	tonnes	10,31#3
Other purchased gas	MWh	1
Coal products		
Pit coal, briquettes#2	tonnes	7,80556
Coke and semi-coke of coal#2	tonnes	7,92
Petrol coke#2	tonnes	9,72
Steam and district heating		
Steam	toe	11,75
District heating	MWh	1
Solid biomass and wastes		
Fire wood, waste of wood	m3	2,33
Wood pellets	kg	0,0048
Waste of wood and other hazardous waste	MWh	1
Other purchased energy	MWh	1
Petroleum products for transport		
Gasoline	litres	0,00917
Auto diesel, dutiable	litres	0,01
Marine gas oils	litres	0,01
Self-produced energy		
Self-produced wood waste	m3	2,33
Self-produced blac liquor	MWh	1
Other self-produced waste	MWh	1
Self-produced steam and heat	MWh	1
Self-produced electricity	MWh	1
Self-produced Natural gas (in gaseous form	MWh	1
Self-produced refinery gas	tonnes	13,5
Self-produced fuel gas	tonnes	13,88889

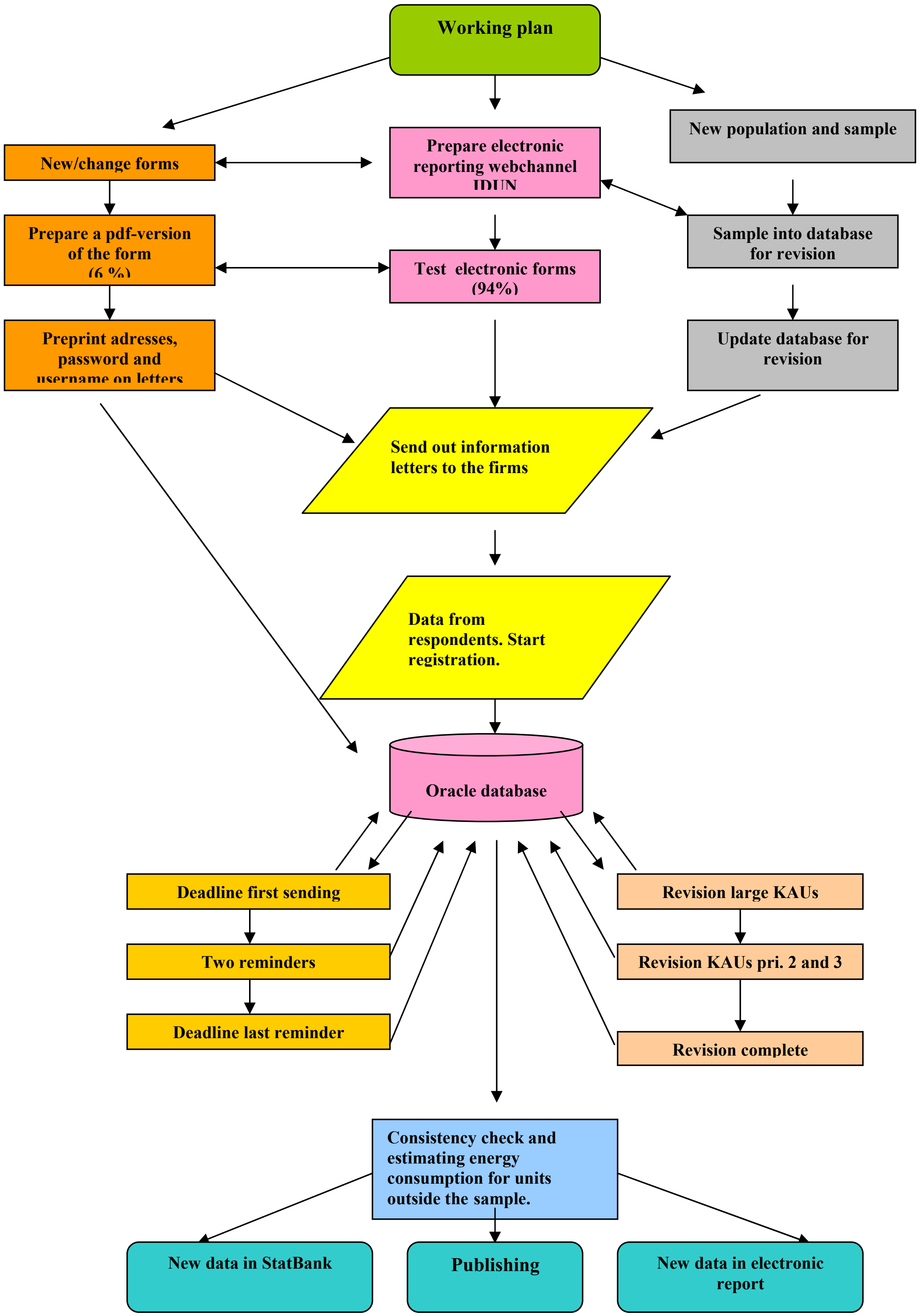
Self-produced CO-gas	tonnes	10,31
Other self-produced gas	MWh	1
Othe self-produced energy	MWh	1

#1 Occasional power and grid rent included

#2 Coal, coke etc. used as reducing agent during production is considered as fuel in the energy balance.

#3 Must be updated each year

Appendix B: Process map of the energy consumption in manufacturing statistics



Appendix C: Questionnaires for energy consumption in manufacturing sector

1 Use of purchased energy 2006

Some local KAUs may have energy costs included in rent. If this occurred for this unit, please put a cross beneath.

☐ Energy costs partly included in rent.
☐ *All* energy costs included in rent.

Please report the consumption of purchased energy

Please report the consumption of the originally energy products. Use of energy delivered from other local KAUs in the company is classified as purchased. Include use of waste as energy source, even if the unit doesn't pay for it.

	Quantity		Value in 1000 kr (excl. VAT)
☐ **Electricity** (grid rent included)		1 000 kWh	
☐ Non-priority		1 000 kWh	
☐ Electricity used in heat pump		1 000 kWh	
Petroleum products (excl. used for transport)			
☐ Auto diesel, non-dutiable (Conversion: 0,84 m.t. pr. 1 000 litre)		M.T.	
☐ Light heating oils (Conversion: 0,84 m.t. pr. 1 000 litre)		M.T.	
☐ Heavy distillates (Conversion: 0,88 m.t. pr. 1 000 litre)		M.T.	
☐ Heavy fuel oils (Conversion: 0,98 m.t. pr. 1 000 litre)		M.T.	
☐ Kerosene (Conversion: 0,98 m.t. pr. 1 000 litre)		M.T.	
☐ Waste oil (Conversion: 0,98 m.t. pr. 1 000 litre)		M.T.	
Coal Products			
☐ Pit coal, briquettes		M.T.	
☐ Coke and semi-coke of coal		M.T.	
☐ Petrol coke		M.T.	

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Gas	Quantity		Value in 1000 kr (excl. VAT)
☐ Propane and butane (Conversion: 0,98 m.t. pr. 1 000 litres)		M.T.	
☐ Natural gas (in gaseous form)		1 000 Sm^3	
☐ Liquified natural gas (LNG)		M.T.	
☐ Acetylene used to welding		kg	
☐ Other purchased gas (specify) (e.g. CO-gas, fuel gas)			
....		1 000 kWh	

urchased wood and hazardous waste			
☐ Fire wood, waste of wood		m^3	
☐ Hazardous waste		1 000 kWh	

Purchased steam and district heating			
☐ District heating		toe	
☐ Steam		1 000 kWh	

Petroleum products for transport			
☐ Gasoline		litre	
☐ Auto diesel, dutiable		litre	
☐ Marine gas oils		litre	
☐ No transport or transport hire			

Other purchased energy			
☐ Specify energy product			
....		1 000 kWh	

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2 Use of self-produced energy 2006

Exclude sold self-produced energy. Exclude self-produced energy produced from purchased energy.

	Quantity	
☐ Self-produced wood waste		m³
☐ Self-produced black liquor		1 000 kWh
☐ Other self-produced waste		1 000 kWh
☐ Recycling of steam		1 000 kWh
☐ Self-produced electricity		1 000 kWh
☐ Self-produced gas		1 000 kWh
☐ Other self-produced energy		1 000 kWh

3 Information about manufacturing activity 2006

Please report the local KAUs final product. Exclude trade with commercial goods.

Total manufacturing activity [ ] ☐ M.T. ☐ m³ ☐ Litre

4 **Comments** (supplementary information, problems with the form, advices):

Thank you!